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Trauma in human remains from Bronze Age and Iron Age archaeological sites in Armenia

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Abstract: *This paper reports on the prevalence of traumatic bone lesions among Bronze and Iron Age populations in Armenia. A total of 51 traumatic injuries were observed in a sample of 147 individuals from 8 sites. Injuries were present in 37 males (46.3%, n=80), 13 females (28.9%, n=45), and 1 child (5%, n=20). In four sites (N. Getashen, Noraduz, Shirakavan and Lori Berd) the most affected age class was 20–29 years, in two other sites (Sarukhan and Arszvakar), the most affected age class was 40–65 years. Some kinds of trauma may be attributed to inter-personal violence, although it was not possible to distinguish between intra-community (e.g. domestic) and inter-community violence.*

Key words: skeletal trauma; warfare; fractures

Introduction

The Armenian Highland was in early history a crossroads, linking the East and West. Overland trade routes existed between the Near East through the Armenian Highlands and the Caucasus and on to the Balkans, and through Caucasus and the Balkans to the north Black Sea coast and back. Since the Early Bronze Age the ethnic history of the region developed under the interaction of various groups, among which the Indo-European tribes played an important role (Khudaverdyan 2011a, b).

At the end of the fourth millennium and beginning of the third millennium, there was an important farming culture in the Armenian plateau called the Kura-Araxes culture. Wheat and a variety of vegetables and fruits were grown and sheep, goats, donkeys, and horses were bred, so that the food supply was ample for the entire region. Metal goods and pottery were produced and widely distributed, having been found in the Dagestan, Chechnya, Volga, Dnieper and Don-Donets drainages in the north, in Syria and Palestine in the south, and in Anatolia to the west (Badalyan & Avetisyan 2007; Gadzhiev 1966; Krupnov 1966; Nechitailo 1991; Pystovalov 2002; Trifonov 1991; Sagona & Abramishvili 2008).

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Odontological and craniological data identified close affinities between the Armenian Plateau samples (Kura-Araxes culture) and contemporary samples from the Ukraine and Moldova (Tripolye culture) (Alekseeva & Krus 1999; Khudaverdyan 2009, 2011a, b). For later periods, there is also evidence of phenetic affinity between the populations of Armenia (c. 11th–8th c. BCE) and Eastern Europe (Timber Grave culture and Srubnaya culture) (Debets 1954; Dubova 2010; Khokhlov 2000; Khudaverdyan 2011a, b, c; Konduktorova 1956, 1969; Kruts 1984; Shevchenko 1984, 1986). Hence, it is possible to outline cultural and ethnic interactions in antiquity and the known role of the Armenian Plateau as an intermediary between ancient areas of distribution of Tripolye cultures and the Orient (Lang 2005; Martirosyan & Mnacakanyan 1973; Passek 1949). The Armenian Plateau and Georgian samples (Kura-Araxes culture) and the Catacomb culture samples from Kalmykia and Ukraine, exhibit very close affinities to each other. Such contacts continued until the Late Bronze Age (Khudaverdyan 2011a). At the Late Bronze Age Armenian necropolises among the usual graves with human skeletons there were burials of horses and a chariot (Devejyan 1981; Kuftin 1941; Simonyan 2006).

According to the archaeological record (Kyshnareva 1990), the Bronze Age was a time of population growth. Trade networks expanded and social systems grew in complexity. Increasing migration and trade between state-level societies in Eurasia led to a higher incidence of infectious disease (Khudaverdyan 2011c).

Many papers have been published about skeletal samples from Armenia. Most of these, however, focus on osteometrics and especially on cranial studies (Alekseev 1974; Khudaverdyan 2011a, b; Palikyan 1990), as well as on epidemiology (Khudaverdyan 2011c). Very little is known about traumatic lesions in human skeletal remains of ancient Armenia in the Bronze Age and Early Iron Age (Khudaverdyan 2012). The present paper provides a contribution that aims to reduce this gap. The analysis of skeletal trauma may provide a more thorough understanding of the quality of life in ancient Armenia. Although many skeletons under study were fragmented or disarticulated, their analysis can still contribute to knowledge of interpersonal violence and accidental traumatic injuries in prehistory.

Material and methods

The present paper discusses human remains from 8 archaeological sites in Armenia (**Figure 1**). The Early Bronze Age sample is represented exclusively by burials from Kaps, while the samples from later periods were excavated at several different sites. Kaps is an Early Bronze Age site located on the Shirak plateau that was occupied from c. 4000 to 3000 BCE (Kura-Araxes culture) (**Figure 2**). A multiple burial was excavated there containing the remains of three individuals, together with rich grave goods (Petrosyan et al. 2009; Eganyan 2010).

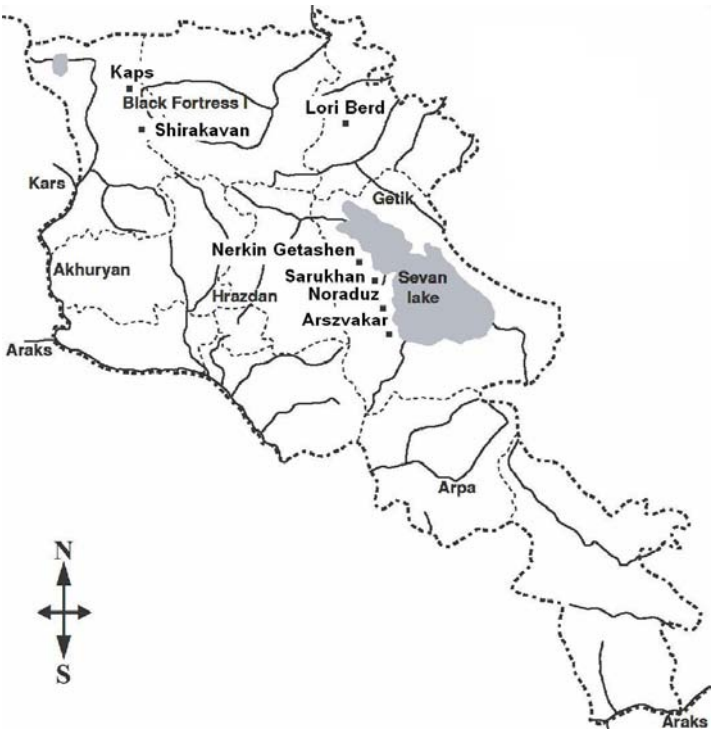

Figure 1. Map of Armenia showing the location of the sites discussed in the paper.

The Black Fortress site is remarkable, owing to its archaeological features spanning two periods of ancient Armenian history (Late Bronze Age and Late Antiquity, i.e. 1st c. BCE – 3rd c. CE) (Avagyan 2003; Ter-Markaryan & Avagyan 2000). Several settlements have been found at the site in association with a very large cemetery. The cemetery is located near the Aleksandrapol tower in the city of Gyumri. All of the burials appear to have been primary interments, typical of the Late Bronze Age (c. 14th–12th c. BCE), and oriented in an east-west direction. Intentionally interred remains of small animals were also common (**Figure 3**). In total, the remains of 13 individuals have been recovered at the site.

Nerkin Getashen is a Late Bronze Age site occupied from the 15th–11th c. BCE, located in the Sevan region. The skeletal remains of 32 individuals were recovered, of which several of the graves of male individuals contained spear and javelin points, arrowheads, knives, and swords (Martirosyan 1964). From these burial deposits only the skulls and some postcranial elements were available for study.

Human occupation at Shirakavan began in the 3rd millennium BCE and continued until the 7th/6th c. BCE. Altogether, remains of 21 individuals were found

Figure 2. Burial 1 from Kaps (photograph by L. Eganyan).

Figure 3. Burial 37 from Black Fortress (photograph by S. Markaryan).

in several cemeteries at Shirakavan. All of the burials appear to have been typical Iron Age interments (c. 9th–6th c. BCE), oriented on an east-west axis. The recovered skeletal remains account for only a small proportion of the inhabitants of the site. The cemetery comprise mostly single burials, but double and triple burials are also present. Skeletal remains were recovered as isolated bones and skulls, largely in disarticulated positions. One of the most interesting and unique discoveries made at Shirakavan was that of detached human crania buried together with complete bodies. Among these crania, 2 are female (burial 1, 20-25 years old, see **Figure** 4; burial 4, 16-20 years old) and one is male (burial 1, 50-55 years old). The teeth of these individuals were missing, which suggests that they had been transported from elsewhere after complete skeletonisation. However, skeletons without crania were not discovered in the cemetery. The material excavated sheds light on various aspects of ancient life in the region, testifying convincingly that a complex culture existed all over the Shirakavan area (Torosyan et al. 2002).

Figure 4. Burial 1 from Shirakavan (photograph by L. Eganyan).

Excavations at Lori Berd began in 1969 by S. Devejyan and are still in progress. The site consists of an immense cemetery near the town of Stepanavan in the village of Lori Berd. The site is surrounded on both sides by the valleys of the Dzoraget and Miskhana rivers. An Iron Age (c. 6th–5th c. BCE) settlement area has been identified on a high highland on the left bank of the Miskana River. The settlement's inner rooms had earthen or stonewalls and stone roofs. Despite plundering, the great tombs of Lori Berd still contain archaeological materials of great importance including a large number of rich ornamented ritual vessels, beads of stone and of precious metals, and other items (Devejyan 1981). Devejyan (1981) reported the discovery of weapons in graves of males; especially spear points, arrowheads, bronze and iron knives, and axes, all of which were probably used in warfare. Such finds suggest that warlike activities were important to this Armenian population. The Lori Berd skeletal sample is fragmentary, often with only a few skeletal elements per individual, and the preservation of bone is generally poor. A total of 16 skeletons were excavated at this site.

Table 1. Number of individuals from Armenian sites studied in this paper.

Site	**Sex**	**Age categories**							**Total**
Chronology		**0-10**	**11-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60+**	
Kaps	M					2			2
Early Bronze Age	F					1			1
Black Fortress	M					1	1		2
Late Bronze Age	F			2	3	1	1	1	8
14th–12th c. BCE	?	2	1						3
Nerkin Getashen	M			7	3	6	1	2	19
Late Bronze Age	F			2	2	1		2	7
15th–11th c. BCE	?	6							6
Shirakavan	M			2	1	3	4	2	12
Iron Age, 9th–6th c. BCE	F		1	2	1	3	2		9
Sarukhan	M		1		2	1	3	1	8
Middle/Late Transitional	F				2		1	1	4
Arszvakar	M				1	6	1	2	10
Middle/Late Transitional	F			1			2	1	4
11th–8th c. BCE	?					1			1
Noraduz	M		1	2	3	4	3	4	17
Middle/Late Transitional	F		2	2	1		2	1	8
11th–8th c. BCE	?	8	1		1				10
Lori Berd	M		2			5	3		10
Iron Age	F			1		1	2		4
6th–5th c. BCE	?	2							2
Total		18	9	21	20	36	26	17	147

The human remains examined from the Sevan region consisted mainly of skulls and, to a lesser degree, postcranial elements. The preservation of crania is satisfactory. Late Bronze/Early Iron Age (11th–8th c. BCE) burials were located within settlements in well-defined burial areas. Individual interments were accompanied by metalwork grave goods such as jewelry, weaponry, and pottery.

The Noraduz site is a large cemetery that was excavated in 1960 by H. Martirosyan and is surrounded by various settlement sites. At least 35 adult individuals of both sexes and all ages were recovered at the site along with stone and bone tools and ornamental objects. Skeletons from Noraduz, Nerkin Getashen, Sarukhan, and Arszvakar are a part of collection gathered by Anna Palikyan.

In total the sample used for the present study consisted of 147 skulls and some postcranial remains (**Table 1**). Age-at-death and sex were assessed through the use of multiple indicators. Sex determination was carried out using cranial morphological markers (glabella, mastoid process, supra-orbital ridge, nuchal crest, parietal eminence, orbit, palate, occipital condyle, external occipital protuberance, styloid process, fronto-nasal junction, mandible, mental protuberance, and teeth) (Buikstra & Ubelaker 1994). Age categories were estimated based largely on methods using the pubic symphysis (Buikstra & Ubelaker 1994; Gilbert & McKern 1973; Katz & Suchey 1986; Meindl et al. 1985) and auricular surface (Buikstra & Ubelaker 1994; Lovejoy et al. 1985). When the innominate was absent, other methods were used, including long bone epiphyseal closure, dental wear, and cranial suture closure (Alekseev & Debets 1964; Buikstra & Ubelaker 1994; Meindl et al. 1985; Phenice 1969). For subadults, dental development and eruption, long bone length, and the appearance of ossification centers and epiphyseal fusion were used (Buikstra & Ubelaker 1994; Ubelaker 1989; Moorrees et al. 1963a, 1963b).

Traumatic lesions were observed both in cranial and postcranial skeletal remains. Antemortem trauma was distinguished from perimortem trauma by the appearance of new bone deposits, resulting in callus formation or beveled edges (Aufderheide & Rodriguez-Martin 1998). Due to small sample size, no statistical testing of inter-sex or inter-site differences was applied.

Cranial trauma

Crania from all sites, except Kaps, exhibited traumatic lesions (see **Table 2**). The highest number of lesions were found in individuals from Lori Berd (9/16), followed by Sarukhan (5/12 subjects) and Shirakavan (7/21). The highest frequencies of cranial lesions are apparent in samples from Black Fortress and Arszvakar, and they mainly affect males. Of all the children recovered, only one exhibited cranial trauma.

One middle-aged male from Shirakavan appears to have undergone probable traumatic cranial lesions. The hole in the left parietal bone (approximately 34mm in diam-

eter) on skull is not round—it appears round in the upper part and then has straight sides more inferiorly (see **Figure 5**). Unfortunately, the skull was strongly eroded and affected by heavy root etching, so this case remains dubious.

Figure 5. Injury on the left parietal bone (Shirakavan, burial 11, male, 45-50 years).

Subject 10 from Sarukhan (**Figure 6**) exhibits a circular blunt force trauma (3.5× 3cm and 1.7mm of depth) in the left parietal bone with clear signs of healing; the inner table is intact. The skull of a mature male (N. Getashen, 25-29 years old, **Figure 7**) also exhibits a large and shallow depressive fracture on the right parietal bone. The wound was well healed with new bone formation.

Table 2. The distribution of traumatic lesions to the skull by sex, affected/observed individuals.

Site	Parietal		Frontal		Occipital		Nasal		Total	
	M	F	M	F	M	F	M	F	M	F
Black Fortress	2/2	2/8	0/2	0/8	0/2	1/8	0/1	0/6	2/2	3/8
Nerkin Getashen	0/19	0/7	4/19	1/7	0/16	0/7	0/14	1/7	4/19	2/7
Sarukhan	1/8	1/4	2/8	1/4	0/8	0/4	0/5	0/1	3/8	2/4
Arszvakar	1/10	0/4	1/10	0/4	0/8	0/4	0/7	0/2	2/10	0/4
Noraduz	0/17	0/8	2/17	2/8	0/17	0/8	1/17	0/8	3/17	2/8
Lori Berd	6/10	1/4	1/10	0/4	0/9	0/2	0/8	0/2	7/10	1/4
Shirakavan	2/12	4/9	1/12	0/6	0/8	0/7	0/8	0/6	3/12	4/9
Total	12/78	8/44	11/78	4/41	0/68	1/40	1/60	1/32	24/78	14/44
% Affected	15.4	18.2	14.1	9.8	0.0	2.5	1.7	3.1	30.8	31.8

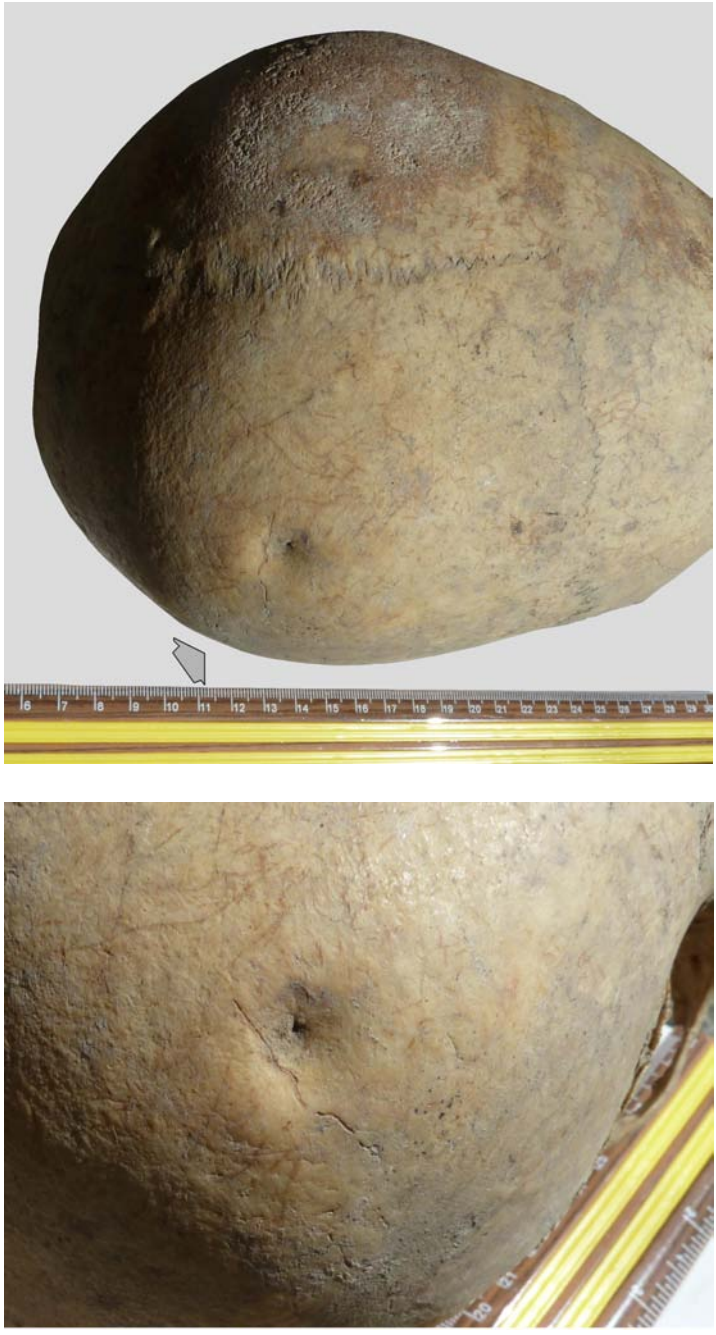

Figure 6. Depression fracture on the left parietal (Sarukhan, burial 10, female, 40-45 years).

Figure 7. Linear fracture with shallow depression on the right parietal bone (Nerkin Getashen, male, 25-29 years).

Figure 8. Angular blade wound (Shirakavan, burial 1, male, 20-25 years).

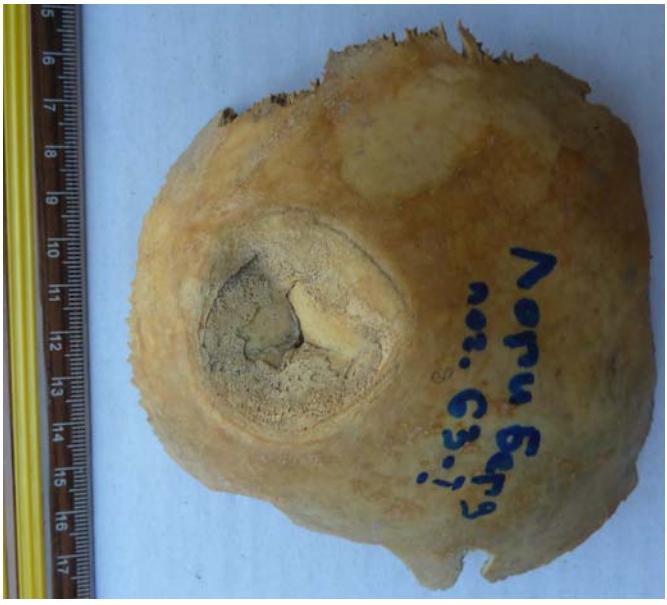

Figure 9. A case of a traumatic penetrating wound in the skull (Lori Berd, burial 63-I, child 4-6 years).

Figure 10. Injury on the left parietal bone (Sarukhan, burial 5, female, 25-30 years).

Figure 11. Fracture of the nasal bones (Noraduz, burial 19, female, 40-45 years).

Another cranium (Shirakavan, burial 1, male 20-25 years old, **Figure 8**) shows a possible large angular blade wound, 7cm long and 2.5mm deep, which occurs on the superior aspect of the right parietal. However, the region of the lesion bone is strongly damaged by taphonomic agents in that area, so this case is dubious, the more that the lesion does not perforate the endocranium. A compressive fracture with partially remodeled bone is present on the parietal bone of a 4-6 years old child from burial 63-I at Lori Berd (**Figure 9**). The lesion has an oval form with diameters of 4.2–3.5cm.

The cranium of a male individual (Sarukhan, burial 2, 40-45 years old) presented evidence of a well healed antemortem irregular trauma on the right frontal bone together with some areas of postmortem damage (**Figure 10**). Because the fracture occurred several years before death, the margins of the traumatic injury are smoothed and the initial compressed bone region has been reduced and replaced by normal bone.

Nasal bone trauma was observed in one individual from Noraduz (burial 19, male, 35-40 years old; **Figure 11**). The nose was considerably deformed and the displacement of bone fragments was apparent.

Postcranial skeleton

Because of a lack of preservation of complete skeletons from Nerkin Getashen, Noraduz, Arszvakar, Shirakavan, Sarukhan and Lori Berd, postcranial traumatic lesions were only observable from isolated elements from a few individuals (**Table 3**). Skeletal material from Nerkin Getashen (burial 1, male, 20-25 years old) contains an example of trauma to the pelvis in the form of an arrow wound to the left ilium (**Figure 12**). The direction of the arrow penetration indicates an entry through the lower abdomen. The lack of healing suggests that this injury likely was a key contributor to the death of this individual. Penetrating wounds to the abdomen are associated with high mortality given the danger of damaging major arteries and nerves within the abdominal region, as well as the high risk of infection associated with potential injury of the intestines and possible leakage of fecal matter (Connor & Mowat 1915). Similar pelvic injuries were observed among individuals from the Smith's Knoll sample from the War of 1812 in North America (Kaufman 2003). Tombs of the Armenian Bronze Age (e.g., near Lchashen, on the Lake Sevan coast) contained spear and javelin points, arrowheads, knives, swords of war and chariots, which provide supportive evidence for the occurrence of warfare in this region (Martirosyan 1964).

An ulna fracture that occurred about 7.6cm from the distal end of the left ulna in a female from Black Fortress (burial 37, 30-40 years old, **Figure 13**) may have been caused by an attack. The fracture healed but remains evident in the form of a pseudoarthrosis. The position suggests that the injury resulted from parrying a blow to the face or upper body (Kricun 1994; Pretty & Kricun 1989).

A blow appears to have cut off part of the right humerus of a male individual from Kaps (45-50 years old, **Figure 14**). Taking into account the tools and weapons used by the populations from Armenia during this time, the only objects that show an approximately round profile are a special hatchet (Martirosyan 1964) and a hammerhead similar to those used today by masons and brick workers.

Enthesophytes on the right fibula (**Figure 15**), bony outgrowths at the site of ligament attachments may have caused discomfort in the lower leg. Constant stress can cause enthesopathies (osseous reactions) or cortical bone defects at the site of muscle or ligament attachments when they lose the capacity to properly absorb the stress imposed (Hawkey & Merbs 1995). Enthesopathies are commonly caused by constant micro-trauma, but may also be the result of inflammatory disease, endocrine or degenerative diseases, as well as severe sudden trauma (Resnick & Niwayama 1983). Considerable muscle trauma, which may have caused discomfort was also observed in the right femur on a male skeleton (N1) from Kaps (**Figure 16**).

The collection from Arszvakar (burial 4, male, 45-50 years old) contains an example of trauma to the lower limbs. This middle-aged man presented with fusion of the tibia and fibula (**Figure 17**). This defect must have considerably diminished the normal biomechanical function of the leg bones, resulting in increasingly degenerative processes in the affected areas.

Discussion

A total of 51 traumatic injuries were observed in the remains of 147 individuals from Armenian Bronze Age and Iron Age sites. The injuries are distributed among 37 males, 13 females, and 1 child. Of these, 42 were cranial injuries (28.6% affected). Approximately 16.4% of the combined sample from Armenia (20 of 122) showed traumatic lesions to the parietal bone. The parietal lesions tended to be left-sided (11 of 20), which may indicate that the injuries resulted from face to face assault

Table 3. The distribution of postcranial traumatic lesions.

Site	Humerus	Ulna	Femur	Fibula	Ilium
Kaps	1/3	0/3	1/3	0/3	0/3
Black Fortress	0/8	1/8	0/8	2/8	0/8
Nerkin Getashen	0	0	0	0	1/1
Arszvakar	0	0	0	1/1	0
Lori Berd	0/10	0/8	0/11	1/10	0/9
Shirakavan	0/17	0/17	0/17	0/17	0/17
Total	1/38	1/36	1/39	4/39	1/38
% Affected	2.6	2.8	2.6	10.3	2.6

Figure 12. Projectile wound of the ilium (Nerkin Getashen, male, 20-25 old).

Figure 13. Fracture of the ulna with pseudoarthrosis (Black Fortress, burial 37, female, 35-40 years).

Figure 14. Healed trauma on a humeral neck (Kaps, N 3, male, 45-50 years).

Figure 15. Healed fibular fracture (Black Fortress, burial 14, male, 45-50 years).

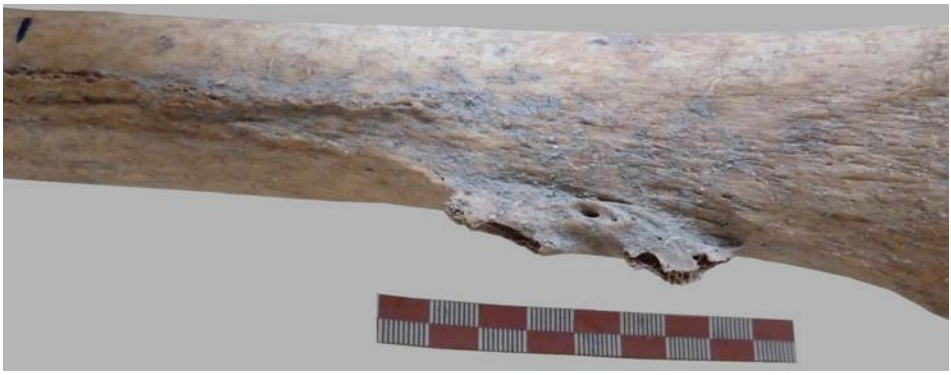

Figure 16. Muscle trauma on the femur (Kaps, N 1, male, 45-50 years).

Figure 17. Fracture of the tibia and fibula resulting in fusion at both ends (Arszvakar, burial 4, male, 45-50 years).

by right-handed attackers (Atta 1999). Lovell (1997) reported that fractures of the cranium are more likely to be related to interpersonal violence than fractures of the long bones, which are typically associated with falls and other accidents. Injuries were also observed on the humerus, ulna, ribs, os coxae, femur, tibia, and fibula. One of the main causes of humeral fractures is a direct blow from a hatchet or another weapon (Martirosyan 1964), especially when the aggressor who seeks to inflict a wound to an opponent's skull misses the head and instead hits the shoulder (Khudaverdyan 2012). It cannot be determined with certainty which humeral fractures occurred as a result of interpersonal violence and which were the result of accidents, however the evidence suggests that at least some part of these traumatic injuries occurred as a result of deliberate interpersonal violence. Fractures of the fibula and femur are found on various individuals and are suggestive of accidental trauma in populations from Armenia.

In the eight analysed samples, bone fractures are more common in skeletons belonging to middle-aged adults in comparison with the skeletons of younger adults. This situation is logical considering that traumatic injuries to bone are, like some other pathological changes (e.g., dental disease), age-dependent, i.e. their frequency increases with advanced age. However, the age distribution of injuries to the cranium shows a different pattern, where injuries are most common in the age group 20-29. Given that many of these injuries are healed, these data suggest that this was the age during which most cranial injuries were sustained (**Table 4**).

Table 4. The distribution of traumatic lesions to the skull by age-at-death, affected/observed individuals.

Site	**0-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60+**	**Total**	**%**
Kaps	0/0	0/0	0/0	1/3	0/0	0/0	1/3	33.3
Black Fortress	0/3	0/2	3/3	2/2	0/2	0/1	5/13	38.5
Nerkin Getashen	0/6	5/9	1/5	1/7	0/1	0/4	7/32	21.9
Sarukhan	0/1	0/0	0/4	1/1	4/4	0/2	5/12	41.7
Arszvakar	0/0	1/1	0/1	1/7	0/3	1/3	3/15	20.0
Noraduz	0/12	2/4	1/5	1/4	0/5	1/5	5/35	14.3
Lori Berd	2/4	1/1	0/0	2/6	4/5	0/0	9/16	56.3
Shirakavan	0/1	4/4	2/2	1/6	0/6	0/2	7/21	33.3
Total	2/27	13/21	7/20	10/36	8/26	2/17	42/147	
% Affected	7.4	61.9	35.0	27.8	30.8	11.8	28.6	

Approximately 32.5% of the combined sample from Shirak plateau (12 of 37) showed injuries to the cranium. The majority of these cases were consistent with injuries inflicted by blunt force objects, where the point of impact, radiating fractures, and concentric fractures could be identified. Evidence of trauma was present in the combined sample from the Sevan region (19.2%, 18 of 94); however, the frequency

of injuries in the Sevan region was lower than that of Shirak plateau. The highest frequencies of cranial lesions are observed at Lori Berd (57.2%), Black Fortress (50%), and Sarukhan (41.7%), and they mainly involved males. The frequency of injuries in the Sevan region was lower than at Shirak plateau and plateau Tashratap. Unfortunately, at this moment it cannot be determined with certainty whether the intentional violence occurred within the community (e.g., domestic violence) or between communities due to high competition levels.

Conclusions

By examining traumatic bone lesions in the archaeological record, one may reconstruct aspects of the social and physical environments of past populations. This study has focused on the traumatic lesions of skeletons among several Bronze and Iron Age populations in Armenia. The data obtained suggests that the frequency of cranial trauma is quite variable in all of the studied samples and ranges from 14.3% to 56.3%. There is only minimal evidence for significant violence (e.g., embedded weapons and individuals with several fractures, including fractures of cranial and nasal bones), and the frequencies of possible defensive parry fractures to the ulna was less than 8% for the sample examined in this study.

Taking into account the observed bioarchaeological characteristics of individuals buried in Kaps, Black Fortress, Nerkin Getashen, Shirakavan, Sarukhan, Arszvakar, Noraduz, and Lori Berd it may be concluded that the everyday life of the Bronze Age and Iron Age populations in the region of contemporary Armenia was harsh. Although the recorded bone fractures strongly suggest the presence of interpersonal violence in the studied communities, the exact nature of the violence cannot be determined. Considering that anthropological studies of Bronze Age and Iron Age human skeletal remains from the Armenia territory have rarely been published, this research along with previously published analyses, represents only the initial step in creating a much larger database of palaeopathological characteristics of the Bronze Age and Iron Age inhabitants of Armenia.

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